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EPA Contract No. 68-W9-0036
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EPA Project Officer: Diana King
EPA Remedial Project Manager: Elaine Stanley

FINAL REPORT FIVE YEAR REVIEW

**Charles George Reclamation Landfill
Tyngsborough, Massachusetts**

August 1995

Prepared by:

M&E Metcalf & Eddy
An Air & Water Technologies Company

REPORT

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**FINAL FIVE YEAR REVIEW
FOR THE
CHARLES GEORGE RECLAMATION LANDFILL**

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TYNGSBOROUGH, MASSACHUSETTS**

August 1995

Prepared by:



Wakefield, Massachusetts

**SITE ACTIVITIES SUMMARY
FIVE-YEAR REVIEW
for the Charles George Reclamation Landfill**

TABLE OF CONTENTS

	<u>Page</u>
1.0 BACKGROUND	1-1
1.1 INTRODUCTION	1-1
1.1.1 Purpose of Report	1-1
1.1.2 Summary of Remedy Stipulated by Records Of Decision	1-3
1.1.3 Report Organization	1-7
1.2 REMEDIAL OBJECTIVES	1-7
1.3 STANDARDS REVIEW	1-9
1.3.1 Historical Analytical Data Review	1-9
1.3.2 Historical Sediment Toxicity Testing Data Review	1-11
1.3.3 ARARs Review	1-12
1.3.3.1 Chemical-Specific ARARs.	1-26
1.3.3.2 Location-Specific ARARs.	1-51
1.3.3.3 Action-Specific ARARs.	1-52
1.4 RISK ASSESSMENT REVIEW	1-52
1.4.1 Human Health Risk Assessment	1-52
1.4.2 Ecological Risk Assessment	1-56
 2.0 PRESENT SITE CONDITIONS	 2-1
2.1 SUMMARY OF SITE ACTIVITIES	2-1
2.1.1 Cap Inspection	2-1
2.1.2 Sediment Sampling	2-6
2.1.3 Off-site Wetlands Investigation	2-11
2.1.3.1 Methods of the Off-site Wetlands Investigation	2-11
2.1.3.2 Findings of the Off-site Wetlands Investigation	2-14
2.1.4 On-Site Wetlands Characterization	2-30
2.1.5 Field Habitat Characterization and Wildlife Observations	2-41
2.1.6 Fish Tissue Sampling	2-45
2.2 ANALYTICAL RESULTS SUMMARY	2-52
2.2.1 Sediment Results Summary	2-52
2.2.1.1 Volatile Organics	2-54
2.2.1.2 Semi-Volatile Organic	2-54
2.2.1.3 Polycyclic Aromatic Hydrocarbons (PAHs)	2-54
2.2.1.4 Metals	2-54
2.2.1.5 Antimony and Cadmium	2-67
2.2.1.6 Organic Content and Grain Size	2-67

TABLE OF CONTENTS

	<u>Page</u>
2.2.1.7 Toxicity Testing	2-67
2.2.2 Fish Tissue Results Summary	2-76
2.2.2.1 Metals.	2-76
3.0 EVALUATION OF DATA	3-1
3.1 EVALUATION OF SEDIMENT DATA	3-1
3.1.1 Evaluation of Sediment Analytical Data	3-1
3.1.1.1 Volatile Organics	3-1
3.1.1.2 Semi-Volatile Organics	3-6
3.1.1.3 Polycyclic Aromatic Hydrocarbons (PAHs)	3-11
3.1.1.4 Metals	3-15
3.1.1.5 Antimony and Cadmium	3-20
3.1.1.6 Organic Content and Grain Size	3-24
3.1.2 Evaluation of Sediment Ecological Toxicity	3-26
3.1.3 Evaluation of Human Health Risk from Exposure to Sediment	3-31
3.2 EVALUATION OF FISH TISSUE DATA	3-37
3.3 SITE COMPLIANCE	3-46
3.3.1 Compliance with ROD I	3-46
3.3.2 Compliance with ROD II	3-47
3.3.3 Compliance with ROD III	3-49
4.0 RECOMMENDATIONS	4-1
4.1 RECOMMENDED TECHNOLOGIES	4-1
4.1.1 ROD I	4-1
4.1.2 ROD II	4-1
4.1.3 ROD III	4-2
4.2 STATEMENT OF PROTECTIVENESS	4-4
4.2.1 ROD I	4-4
4.2.2 ROD II	4-5
4.2.3 ROD III	4-6
4.3 NEXT REVIEW	4-7
4.3.1 ROD I	4-7
4.3.2 ROD II	4-7
4.3.3 ROD III	4-8
4.4 IMPLEMENTATION REQUIREMENTS	4-8
4.4.1 ROD I	4-8
4.4.2 ROD II	4-9
4.4.3 ROD III	4-9

TABLE OF CONTENTS (Continued)

APPENDICES

Appendix A - Acronyms and Abbreviations

Appendix B - 1993 ARARS Evaluation

Appendix C - Wetland Resource Maps from Previous CGRL Studies

Appendix D - Correspondence with State and Federal Agencies

Appendix E - Three Parameter Wetland Delineation Summary Sheets

Appendix F - Analytical Data

LIST OF FIGURES

	<u>Page</u>
1-1 Charles George Reclamation Landfill Site Location	1-2
1-2 Charles George Reclamation Landfill Site Map	1-4
2-1 Sediment Sampling Locations	2-8
2-2 Topographic Map of Charles George Landfill	2-15
2-3 National Wetlands Inventory Map of Charles George Landfill	2-16
2-4 SCS Soil Survey Map of Charles George Landfill	2-18
2-5 100-Year Floodplain Map of Charles George Landfill	2-19
2-6 Field Map of Wetland Habitats	2-32
2-7 Sampling Locations for Fish Tissue Samples	2-46

LIST OF TABLES

	<u>Page</u>
1-1 Potential Chemical Specific ARARS Criteria, Advisories, and Guidances	1-14
1-2 Comparison of ROD-Specified Numerical, Chemical-Specific ARARS, and Criteria for Groundwater and Leachate (1988-1993)	1-23
1-3 Comparison of ROD Specified Numerical, Chemical-Specific ARARS and Criteria for Surface Water and Sediment (1988-1993)	1-27
1-4 Comparison of Numerical, Chemical-Specific ARARs and Criteria for Groundwater and Leachate with Historical Analytical Results	1-29
1-5 Numerical, Chemical-Specific ARARs for Soil	1-31
1-6 Comparison of Numerical, Chemical-Specific ARARs and Criteria for Sediment with Historical Analytical Results	1-32
1-7 Potential Location-Specific ARARs, Criteria, Advisories, and Guidance	1-33
1-8 Potential Action-Specific ARARs	1-38
1-9 Sediment Concentrations 1987-1988	1-54
1-10 Changes in Reference Doses and Slope Factors 1988-1994	1-55
1-11 Possible Charges in Exposure Parameters 1988-1994	1-57
2-1 Sediment Sampling and Analytical Summary	2-7
2-2 Wildlife Species Observed During Natural Resource Surveys at the Charles George October 20 - October 22, 1992	2-42
2-3 Charles George Reclamation Landfill Fish Sampling Data October 4, 1993	2-48
2-4 Volatile Organics Analytical Results in Sediment	2-55
2-5 Semi-Volatile Organics Analytical Results in Sediment	2-58

LIST OF TABLES (Continued)

		<u>Page</u>
2-6	Polycyclic Aromatic Hydrocarbons (PAH) Analytical Results in Sediment	2-61
2-7	Metals Analytical Results in Sediment	2-64
2-8	Antimony and Cadmium Analytical Results in Sediment	2-68
2-9	Total Organic Carbon Analytical Results in Sediment	2-71
2-10	Total Combustible Organics Analytical Results in Sediment	2-72
2-11	Grain Size Analytical Results in Sediment	2-74
2-12	Ten Day Toxicity Testing Survival Percentages	2-77
2-13	Ten Day Toxicity Testing Growth Data	2-78
2-14	Metals in Fish Tissue Analytical Results	2-79
3-1	Volatile Organics in Sediment Summary	3-2
3-2	Semi-Volatile Organics in Sediment Summary	3-7
3-3	Polycyclic Aromatic Hydrocarbons (PAH) in Sediment Summary	3-12
3-4	Metals in Sediment Summary	3-16
3-5	Antimony and Cadmium in Sediment Summary	3-21
3-6	Sediment Ecological Criteria and 1993 Metals in Sediment	3-27
3-7	Sediment Concentrations 1988 - 1993	3-33
3-8	Changes in Reference Doses and Slope Factors 1988-1994	3-34
3-9	Possible Changes in Exposure Parameters, 1988-1994	3-35
3-10	Summary of Fish Tissue Inorganic Results for Locust Pond Largemouth Bass	3-38

LIST OF TABLES (Continued)

	<u>Page</u>
3-11 Summary of Fish Tissue Inorganic Results for Locust Pond Yellow Perch	3-39
3-12 Summary of Fish Tissue Inorganic Results for Flint Pond Largemouth Bass	3-40
3-13 Summary of Fish Tissue Inorganic Results for Flint Pond Yellow Perch	3-41
3-14 Summary of Fish Tissue Inorganic Results for Between Dams Largemouth Bass	3-42
3-15 Summary of Fish Tissue Inorganic Results for Between Dams Yellow Perch	3-43

SECTION 1.0

BACKGROUND

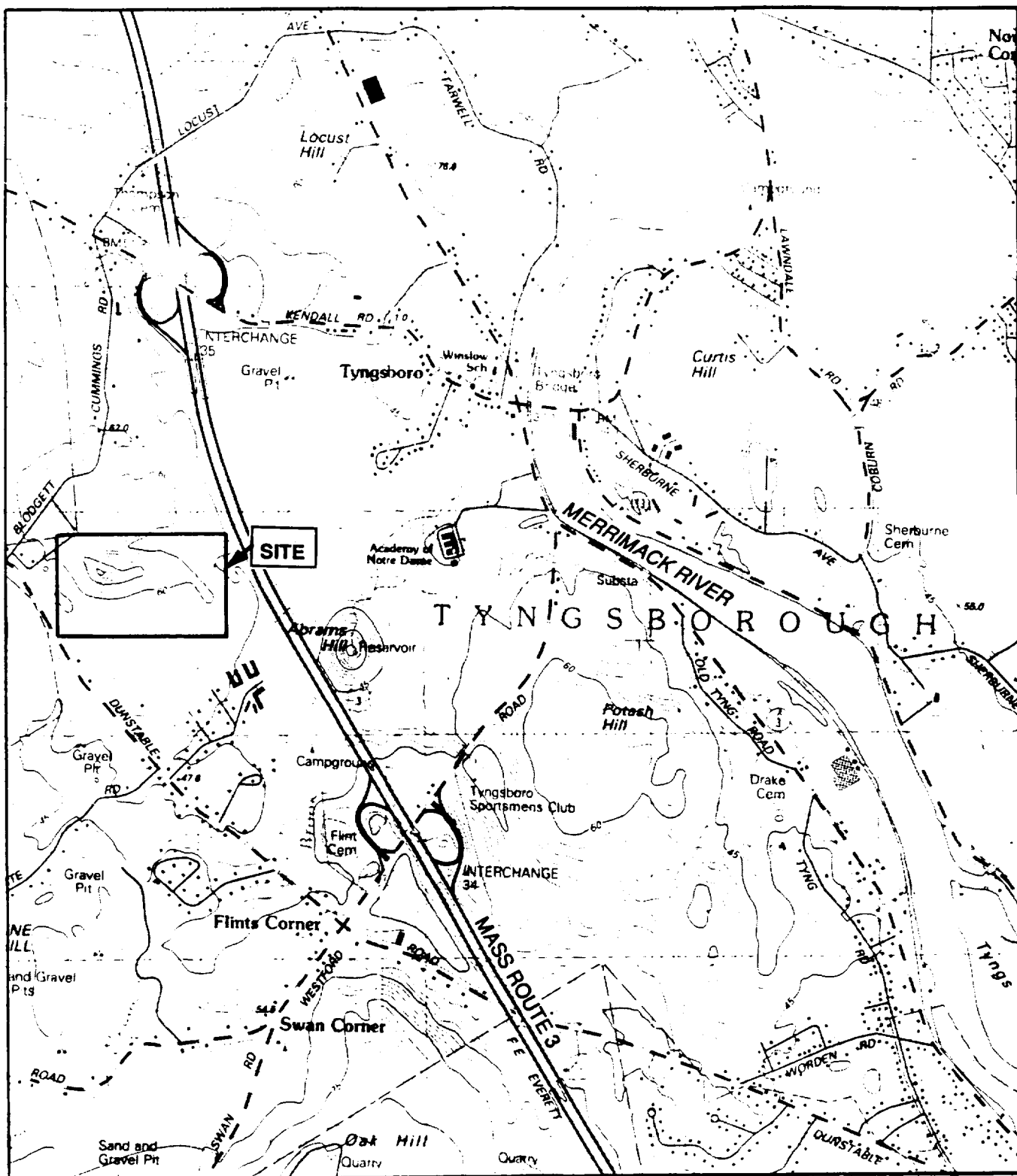
This document is a comprehensive and interpretive report on the five-year review conducted at the Charles George Land Reclamation Trust Landfill Superfund site (the site) in Tyngsboro, Massachusetts, (see Figure 1-1) for U.S. Environmental Protection Agency (EPA) Region I. This work was conducted by Metcalf & Eddy (M&E) under the Alternative Remedial Contract Services (ARCS) contract. The U.S. EPA is the lead agency and decision-maker for the Charles George Land Reclamation Trust Landfill site.

1.1 INTRODUCTION

The five-year review was undertaken to review remedial actions completed at the site to date, to ensure that the remedial actions remain protective of human health and the environment. This review is required by federal statute for any site remedy which results in hazardous substances remaining on-site (CERCLA §121(c) and 40 CFR §300.430(f)(4)(ii)).

1.1.1 Purpose of Report

The purpose of the five-year review is to: (1) confirm that the remedy as spelled out in the ROD and/or remedial design remains effective at protecting human health and the environment; and (2) to evaluate whether original cleanup levels remain protective of human health and the environment. This report presents the results of a "Level II" five-year review, as determined by U.S. EPA Region I and in accordance with OSWER Directive 9355.7-02 "Structure and Components of Five Year Reviews." This review includes elements of a Level II review (document reviews, regulatory review, site inspection, site sampling, statement of protectiveness and recommendations) except the recalculation of risk. EPA instructions for this work assignment specified a qualitative reevaluation of risk without a recalculation.



SOURCE: USGS Lowell Quadrangle 1987



2000 0 2000
SCALE IN FEET

**FIGURE 1-1. CHARLES GEORGE RECLAMATION LANDFILL
SITE LOCATION**

1.1.2 Summary of Remedy Stipulated by Records Of Decision

The Charles George Reclamation Landfill is a sixty-acre mixed industrial, municipal, and hazardous waste landfill located approximately one mile southwest of the town center of Tyngsboro, Massachusetts (see Figure 1-2). Land use in the vicinity of the site is predominantly rural residential but also includes some light industry and seasonal livestock grazing. Drinking water in the area is supplied by local groundwater wells and by a new water main installed as a result of the EPA's first Record of Decision (ROD I) (Phase I) for the site. The water main is connected to the City of Lowell's system. The site is bordered to the east by U.S. Route 3, Flint Pond Marsh, and Flint Pond. Dunstable Road and Dunstable Brook border to the west, and the Cannongate Condominium complex is about 800 feet to the southeast. Blodgett Street forms the northwest border, eventually becoming Cummings Road further north of the landfill.

The landfill itself contains municipal and industrial waste disposed on site from the mid-1950s until the landfill's closing in 1983. The landfill was permitted to accept hazardous industrial waste from 1973 until 1976.

The investigation and remediation of contamination at the site is divided into four distinct operable units as follows:

- ROD I. Provide an alternative water supply.
- ROD II. Control the contamination source to reduce off-site migration of contaminants (i.e., cap the landfill gas and collect the leachate).
- ROD III. Provide treatment of groundwater, leachate and landfill gas and provide removal of Dunstable Brook sediments as the selected source removal remedy. ROD III covered both Operable Unit #3 (management of migration) and Operable Unit #1 (leachate treatment).

Selected remedial actions for the site were developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP) at 40 CFR Part 300. Remedial alternative selection was documented in the Records of Decision (RODs).

ROD I provided a permanent drinking water supply to local groundwater users by extending an existing water supply system. Local groundwater wells were found to contain volatile organic compounds associated with the site. The remedy minimized exposure and, therefore, provided a measure of protectiveness to human health.

ROD II provided a cap for the site including a synthetic membrane and soil cover, a surface water management system, a passive landfill gas venting system, and a leachate collection system. These measures minimized the migration of contaminants through the air and groundwater and, therefore, provided a measure of protectiveness to human health. The landfill cover minimized storm water infiltration which reduces leachate generation. The leachate collection system minimized impacts to off-site surface water and groundwater. The landfill gas collection system delivers landfill gas to an interim flare. The flare, provided under ROD III, thermally destroys contaminants carried in the gas and minimized impacts to the air.

Construction of a synthetic landfill cap and appurtenant systems was begun in early 1989 and completed in October 1990. Included in the construction of the cap were a new shallow perimeter leachate toe-drain, two leachate pump stations with force mains flowing to a temporary leachate holding pond, a passive gas collection and venting system, and a surface water diversion and sedimentation system. The old leachate collection systems on the east and west sides of the landfill, which were installed by the former landfill operator, have been connected into pump stations.

The landfill gas collection and venting system includes a passive, crushed stone gas collection trench system under the cap liner which will direct the landfill gas through 28 vents along the top of the landfill. Twelve pre-existing vents are tied into the new gas collection system below the liner. Landfill gas is being routed to an open flare, part of ROD III, on an interim basis.

ROD III completes the remedial actions via treatment of the media controlled during implementation of ROD II. The southwest groundwater collection trench has been constructed and operating since October 1993. In addition, the residential well monitoring program started in 1989 and continues to date.

The leachate and groundwater will be collected and treated on site. The treatment plant effluent is regulated by cleanup standards established in ROD III and, therefore, minimizes off-site impacts. Currently, leachate is collected in the leachate toe-drain installed with the cap during implementation of ROD II. The leachate is pumped to a lined holding pond. Periodically, the holding pond is pumped, treated onsite and discharged to nearby surface waters. The eastern groundwater remediation is currently in the design phase.

Landfill gas is currently being treated on an interim basis. The final remedy for landfill gas includes short term monitoring of landfill gas quality and quantity under capped conditions, followed by an upgrade, if necessary, to the existing treatment system.

The need for excavation of sediments from Dunstable Brook has been reevaluated as part of this five-year review. Sediments that were to be dredged and placed under the landfill cap during cover construction remain in the brook. The decision to dredge the brook was based on a risk assessment of contaminant levels and risk factors at the time ROD III was issued 1988. In 1989, EPA revised the relative absorption factors for PAHs. These changes were expected to result in decreased human health risk associated with exposure to sediments. Although new risk calculations were not performed, EPA decided not to dredge the brook.

Additional sediment data and a reevaluation of risk factors are presented in Section 2.2 and 3.1.

1.1.3 Report Organization

This document is organized for a Level II review. It presents the results of the five-year review within the following discussions:

Section 1.2, Remedial Objectives presents ROD-specified remedial objectives.

Section 1.3, Standards Review describes the results of a review of existing site documents which pertain to the remedial actions implemented at the site.

Section 1.4, Risk Assessment Review describes the risk factors and equations used during the RI/FS and proposes update alternatives.

Section 2.0, Site Conditions describes the present status of the remedial actions, results of data collected during the five year review, the information obtained during site inspections and the wetlands assessment conducted at the site.

Section 3.0, Recalculation of Risk presents updated sediment risk calculations based on updated quantitative risk factors and site data.

Section 4.0, Recommendations

Section 5.0, References contains references cited in the report.

1.2 REMEDIAL OBJECTIVES

ROD I. The first ROD, issued in December 1983, selected an extension of a water supply line to the residents of the Cannongate/Red Gate Road area. The objective of the new water main, an extension of Lowell's system, was to provide an uncontaminated alternative water service to the residents of the Cannongate Condominium complex and surrounding area.

ROD II. The objective of the second ROD, signed in July 1985, was the implementation of source control measures to contain contamination and thereby minimize any further off-site impacts. The selected remedy described in ROD II includes: a synthetic membrane cap, establishment of a 2:1 grade on the side slopes where required; a surface water diversion and collection system; a vent network with a passive gas collection system and a peripheral leachate collection system.

ROD III. The objective of this ROD, completed September 29, 1988, is on the control and cleanup of contaminants that have spread or are spreading from the site, including the treatment of leachate collected as part of the cap system. EPA selected the three-part remedy outlined below for the cleanup of contaminated groundwater and leachate, landfill gas emissions, and stream sediment. The selected remedies included in the ROD are:

1. Leachate collected from the landfill cap system will be combined with overburden and shallow bedrock groundwater from a groundwater recovery system and treated on-site with biological treatment, hydroxide precipitation, carbon adsorption, and, if necessary, ion exchange units. The treated leachate and groundwater will be monitored and discharged into groundwater on-site, if feasible. If discharge to groundwater is not feasible, the treated leachate and groundwater will be discharged into a nearby approved surface water. An upgradient groundwater diversion trench will also be installed to assist in lowering the water table beneath the landfill, thereby minimizing direct contact between groundwater and landfill wastes. In addition, groundwater monitoring will be performed to provide early warning of possible increases in contaminant concentrations that may impact residential drinking wells in deep bedrock.
2. Landfill vent gas emissions will be collected and thermally destroyed on-site.
3. Contaminated sediments in Dunstable Brook immediately west of the landfill will be dredged, solidified on-site, and placed beneath the synthetic cap constructed over the landfill, per EPA's second ROD.

1.3 STANDARDS REVIEW

This report is based on review of the documents listed in the references section of this report.

1.3.1 Historical Analytical Data Review

Analytical data has been collected at the site since the initial groundwater monitoring in 1979 and 1980. The data reviewed during this five year review, however, do not include results prior to those in the documents used to formulate ROD III.

The selection of residents to receive new water supply service hook-ups was based on groundwater data. The delivery system and pump station designs, however, were not necessarily designed based on site-specific concentrations. Likewise, the landfill cap design was sized, including the leachate toe drain, based on the volume or extent of the leachate and waste, not on the contaminant levels in the leachate or waste (except for HDPE compatibility studies). Based on this reasoning, analytical data reviewed and used in this five year review is all post ROD II data.

Groundwater

Historically several volatile organic compounds, semivolatile organic compounds and inorganic elements have been detected in site groundwater. Some of these analytes are chemicals of concern and are identified as such in RODs II and III. Others are not chemicals of concern but have recently been detected at concentrations that exceed MCLs. Three acid extractable compounds; phenol, 2-methylphenol and 4-methylphenol were identified as chemicals of concern in RODs II and III. Semivolatiles, which include the phenols, have been included in the recent (1990 to date) groundwater monitoring program for both residential and on- and off-site wells. Analytical results are summarized in Table 1-4 which

presents the minimum and maximum concentrations detected and the frequency of detection for samples collected and analyzed between August 1990 and April 1993.

Leachate

The completion of the leachate collection system as part of ROD II remedial measures conducted at the site included a leachate collection pond which has a capacity of approximately 3.5 million gallons. On an interim basis (1991, 1992 and 1994), the USACE has contracted out to treat and discharge contents of the holding pond.

During treatment, leachate from the collection pond was sampled and analyzed for volatile organics, semivolatile organics, metals and several water quality parameters including biochemical oxygen demand, and total suspended solids. Samples of the effluent were also tested for acute and chronic toxicity. The maximum and minimum concentrations of leachate chemicals of concern and other chemicals reported at concentrations greater than their MCLs in the leachate are summarized in Table 1-4. The effluent met all discharge standards set by the Massachusetts DEP for chemical and water quality parameters. The leachate has historically had trouble meeting the whole-effluent toxicity standards (NOEL=100%), although improvements have been made with time. Through several Toxic Identification Evaluation studies conducted by CDM, it appears that ammonia is the major cause of toxicity.

The percentage of treated leachate effluent in water required to produce 50 percent mortality (LC_{50}) was determined in the acute toxicity testing for 24 and 48 hour durations. The percentage of effluent required in a mixture (e.g., 30% effluent, 70% diluent) to produce a limited observed effect concentration (LOEC) and no observed effect concentration (NOEC) was determined in the chronic toxicity testing. The results for four acute and three chronic facility tests are summarized in the following table. Data from toxicity tests conducted by USEPA on sediments collected in the fall of 1993 are provided in Section 2 and evaluated in Section 3.

Acute Toxicity	Concentration of Effluent in Water
LC ₅₀ 24 hour	12 - 94 percent
LC ₅₀ 48 hour	8.5 - 70 percent
Chronic Toxicity	
LOEC	25 - 50 percent
NOEC	12.5 - 25 percent

Sediment

Chemicals of concern for sediments identified in the ROD III (EPA, 1988) for the site included two inorganic elements, arsenic and cadmium, and six carcinogenic polycyclic aromatic hydrocarbons (PAH). The PAHs are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene and indeno(1,2,3-cd)pyrene. The maximum and minimum concentrations detected and the frequency of detection for samples collected and analyzed between 1988 and 1992 are summarized in Table 1-6. Installation of the landfill cap, stormwater runoff, and leachate collection systems, were designed in part to prevent continued contamination of sediments adjacent to the site. These remedial measures should control the source of contaminants and minimize the migration of contaminants through the surface water and sediments in the vicinity of the site.

1.3.2 Historical Sediment Toxicity Testing Data Review

Based on a review of the 1987 Endangerment Assessment report (ATC, 1987) and the Draft Final Remedial Investigation report (Ebasco, 1988), no sediment toxicity tests were conducted during these studies. During treatment and discharge of the leachate holding pond (OHM, 1992) effluent samples were analyzed for toxicity.

1.3.3 ARARs Review

An analysis of newly promulgated or modified requirements of federal and state environmental laws was conducted to determine if they are applicable or relevant and appropriate requirements (ARARs) and to determine if they call into question the protectiveness of the remedy. The following terms, used within this report, require definition: "applicable", "relevant and appropriate", "to be considered (TBC)", "substantive", and "administrative".

"Applicable" requirements are those requirements that are legally applicable to the response action, if that action is not undertaken pursuant to Section 104 or 106 of CERCLA. Due to the variability of characteristics from site to site, it is impossible to determine, by regulation, which requirements are applicable. Those determinations are made on a case-by-case basis and "applicability" is determined objectively.

"Relevant and appropriate" requirements are defined as those requirements that, while not "applicable," are intended to apply to problems sufficiently similar to those encountered at hazardous waste sites that their application is appropriate." (EPA, 1988b) These non-applicable requirements are used only when they are appropriate or relevant to the site and are applied as applicable requirements.

In addition, other environmental and public health guidelines, although not ARARs, may be considered (and are termed "to be considered" or "TBC") to help determine what is protective or are useful in determining CERCLA remedies.

"Substantive" requirements are those requirements that pertain directly to actions or conditions in the environment. Examples include quantitative health or risk-based standards for certain hazardous substances (e.g., MCLs for drinking water), and technology-based standards (e.g., RCRA minimum technology requirements for double liners and leachate collection systems). CERCLA Section 121(e), codified at 40 CFR Part 300.400(e), exempts

any response action conducted entirely at the site from having to obtain a federal, state, or local permit, where the action is carried out in compliance with Section 121. Remedial actions conducted on Superfund sites need comply only with the substantive aspects of applicable or relevant and appropriate requirements and not with corresponding administrative requirements.

"Administrative" requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation (e.g., requirements related to the approval of or consultation with administrative bodies, documentation, permit issuances, reporting, record keeping, and enforcement).

Under Section III.A of Attachment I "Explanation of Five-Year Review Policy" to OSWER Directive 9355.7-02, the Commonwealth of Massachusetts should be requested to identify state ARARs promulgated or modified since ROD signature which may have a bearing on the protectiveness of the remedy. M&E has not formally contacted the Department of Environmental Protection (DEP) regarding this issue.

The basis for the site ROD was developed prior to promulgation of the revised National Contingency Plan (40 CFR Part 300, March 1990) and prior to publication of the *CERCLA Compliance With Other Laws Manual: Parts I and II*, (OSWER Directives 9234.1-01 and 9234.1-02, respectively), although existing Draft ARAR procedures were followed in the ROD. Many changes to the ARARs have occurred over the past five years. These changes are presented in this section via several tables:

Table 1-1: Potential chemical-specific ARARs and guidance identified in the ROD are re-evaluated in this table. The re-evaluation includes a determination of whether the rule is currently ARAR or TBC and whether the remediation is in compliance with the ARAR.

Table 1-2: This chemical-specific ARARs table presents a comparison of the ROD-specified standards (1988) to current (1993) standards for groundwater and leachate chemicals of concern.

**TABLE 1-1
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS**

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Groundwater</u>				
Federal Regulatory Requirements	SDWA - Maximum Contaminant Levels (MCLs) (40 CFR 141.11 - 141.16)	Relevant and Appropriate	<p>MCLs have been promulgated for a number of common organic and inorganic contaminants. These levels regulate the concentration of contaminants in public drinking water supplies, but may also be considered relevant and appropriate for groundwater aquifers used for drinking water.</p> <p>When risks to public health due to consumption of groundwater were assessed, concentrations of contaminants of concern, including benzene and TCE, were compared to their MCLs. Projected concentrations of benzene exceeded the MCL in several locations. SDWA MCLs also were used in setting discharge requirements.</p>	<p>MCLs and non-zero MCLGs have the status of ARARs for areas not directly overlain by waste. Many of the MCLs and MCLGs have changed since ROD completion. A comparison of changes to MCL/MCLG to those used for the ROD is provided in Table 1-2. An updated table is provided in Appendix B. An identification of the most stringent numerical standards and criteria is provided in Table 1-4. Also provided in Table 1-4 is a listing of groundwater COC levels as well as the maximum and minimum detections for the COC. Concentrations of benzene, ethylbenzene, trichloroethene, arsenic, 1,2-dichloroethane, methylene chloride, antimony, cadmium, and nickel all exceeded the MCL in at least one location. Groundwater still requires remediation under this rule.</p>

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Groundwater</u> (contd.)	RCRA - Subpart F, Groundwater Protection Standards, Concentration Limits (40 CFR 264.94(a))	Relevant and Appropriate	Standards for 14 toxic compounds have been adopted as part of RCRA groundwater protection standards. These limits were originally set at MCLs. Groundwater contaminant levels were compared to these limits. Although eastern shallow groundwater is not a potential drinking water source, it does exceed these limits. Therefore it requires remediation.	Site COCs arsenic, chromium, mercury and cadmium are included in the 14 toxic compounds for which standards have been adopted. Currently, only cadmium has a RCRA MCL (0.01 mg/L) that differs from the SDWA MCL (0.005 mg/L). RCRA sets the limit for organic constituents at background levels. Constituents in site groundwater exceed RCRA MCLs for arsenic and chromium, and exceed background concentrations for all organic COCs. Groundwater still requires remediation under this rule.
	RCRA - Subpart F Groundwater Protection Standards, Alternate Concentration Levels (ACLs) (40 CFR 264.94(b))	Relevant and Appropriate	ACLs are one of three possible standards (aside from MCLs and background concentrations) available under Subpart F for setting a clean-up level for remediation of groundwater contamination from a RCRA facility. ACLs may be relevant and appropriate if certain conditions relating to transport and exposure are met. ACLs may need to be determined by EPA. Procedures for developing ACLs are outlined in RCRA Subpart F, Section 264.94(b).	There is no change from the ROD presentation for this ARAR. At this time, ACLs are not being sought.
Massachusetts Regulatory Requirements	Massachusetts Groundwater Quality Standards (314 CMR 6.00)	Applicable	Massachusetts Groundwater Quality Standards have been promulgated for a number of contaminants. When state levels are more stringent than federal levels, the state levels will be used. DEP Groundwater Standards were considered when determining discharge levels.	Current Massachusetts groundwater standards are updated and compared to site groundwater in Tables 1-2 and 1-4. Groundwater underlying the site is designated Class I. Concentrations of arsenic and chromium exceeded these standards in at least one location. Site groundwater requires remediation under this rule.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Groundwater</u> (contd.)	Massachusetts Drinking Water Requirements (310 CMR 22.05 to 22.09)	Relevant and Appropriate	Requirements were considered; however, standards do not apply to contaminants found in site groundwater.	Because the site is within 500 feet of a private water supply well that was in use at the time of site discovery, drinking water requirements are relevant and appropriate. Many of the Massachusetts MCLs have changed since ROD completion; changes are shown on Table 1-2. An updated list is provided in Appendix B. Groundwater requires remediation under this rule.
	Massachusetts Contingency Plan - Groundwater Standards for GW-1 (310 CMR 40-0932, 40.0974(2))	Not identified (add as applicable)	None.	The revised MCP (July 1993) identifies groundwater standards potentially applicable at hazardous waste sites. Groundwater category GW-1 is considered applicable to the site because the groundwater is within 500 feet of a private water supply well that was in use at the time of site discovery (310 CMR 40.0932 (4)(f)). These standards are listed in Table 1-2 and Appendix B.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
Federal Criteria, Advisories, and Guidance	SDWA - Maximum Contaminant Level Goals (MCLGs)	Relevant and Appropriate/ To Be Considered	<p>MCLGs are health-based criteria that are to be considered for drinking water sources as a result of SARA. These goals are available for a number of organic and inorganic contaminants.</p> <p>Projected groundwater concentrations of copper, trans-1,2-dichloroethene, toluene, benzene, and TCE were compared to their MCLGs. For benzene and TCE, MCLGs are set at zero.</p>	<p>Non-zero MCLGs have the status of ARAR for areas not directly overlain by waste. Zero MCLGs cannot have the status of ARARs but are, however, to be considered in developing site remedies. Many of the MCLGs have changed since ROD completion. A comparison of MCLG changes to those used for the ROD is provided in Table 1-2. An updated table, without strikeouts and redlines, is provided in Appendix B. An identification of the most stringent criteria to be considered is provided in Table 1-2.</p> <p>Concentrations of benzene, ethylbenzene, trichloroethene, arsenic, cadmium, 1,2-dichloroethane, methylene chloride, antimony, lead, and nickel all exceeded MCLGs in at least one location. Groundwater requires remediation under this rule.</p>
	Health Advisories (EPA Office of Drinking Water)	To Be Considered	<p>Health Advisories are estimates of risk due to consumption of contaminated drinking water; they consider non-carcinogenic effects only.</p> <p>Health Advisories were considered for contaminants in groundwater that may be used for drinking water.</p>	<p>Table 1-3 provides the latest US EPA health advisories of all COCs for which advisories are available. An updated table is also provided in Appendix B.</p>
	EPA Risk Reference Doses (RfDs)	To Be Considered	<p>RfDs are dose levels developed by EPA for non-carcinogenic effects.</p> <p>EPA RfDs were used to characterize risk due to exposure to contaminants in groundwater, as well as other media. They were considered for non-carcinogens including toluene, 2-butanone, n-dibutylphthalate, acetone, mercury, and thallium.</p>	<p>This factor is one of several factors used to calculate risk at a site, as discussed in Section 1.4. Reference doses and slope factors have changed from 1988, as shown in Table 1-10 for analytes assessed in 1988.</p>

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Groundwater</u> (contd.)	EPA Carcinogen Assessment Group Potency Factors (CAGs)	To Be Considered	<p>Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.</p> <p>EPA Carcinogenic Potency Factors were used to compute the individual incremental cancer risk resulting from exposure to benzene, arsenic, PAHs, trichloroethene, and 1,1-dichloroethene.</p>	This factor is one of several factors used to calculate risk at a site, as discussed in Section 1.4. Reference doses and slope factors have changed from 1988, as shown in Table 1-10 for analytes assessed in 1988.
	Acceptable Intake - Chronic (AIC) and Subchronic (AIS) - EPA Health Effects Assessment (HEA) Documents	To Be Considered	<p>AIC and AIS values are developed from RfDs and HEAs for noncarcinogenic compounds.</p> <p>AIC and AIS values were used to characterize the risks due to several noncarcinogens in various media. These noncarcinogens include cadmium, chromium, copper, and lead.</p>	AICs and AISs have essentially been replaced by RfDs, and are not used in the 1993 updates.
	EPA Office of Water Guidance - Water-related Fate of 129 Priority Pollutants (1979)	To Be Considered	<p>This guidance manual gives transport and fate information for 129 priority pollutants.</p> <p>The manual was used to assess the transport and fate of a variety of contaminants.</p>	There is no change from the ROD presentation for this ARAR.
Massachusetts Criteria, Advisories, and Guidance	Massachusetts Office of Research and Standards Guidelines (ORSGs)	To Be Considered	<p>DEP Health Advisories are guidance criteria for drinking water.</p> <p>DEP Health Advisories were used to develop discharge levels for surface water and groundwater.</p>	The Massachusetts DEP Office of Research and Standards issues guidelines for chemicals for which state MCLs have not yet been promulgated. These guidelines apply to non-chlorinated water supplies and represent a level at or below which adverse, non-cancer health effects are not expected to occur, and which generally has associated with it an excess lifetime cancer risk of less than or equal to one in one million. These criteria are included in Table 1-2.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Discharge to Publicly Owned Treatment Works</u>				
Federal Regulatory Requirements	RCRA - Pretreatment Standards (40 CFR 403) - GLSD POTW Approved Pretreatment Program Requirements	Applicable	<p>Discharges to a POTW must comply with the POTW's EPA-approved pretreatment requirements.</p> <p>POTWs in the area with approved pretreatment programs are being identified and the discharge must be treated to those levels required by the program.</p>	There are no discharges currently occurring to the POTW. These standards would be applicable should any discharges be planned in the future.
<u>Discharge to Surface Water</u>				
Massachusetts Regulatory Requirements	Massachusetts Surface Water Quality Standards (314 CMR 4.05)	Applicable	<p>DEP Surface Water Quality Standards are given for dissolved oxygen, temperature increase, pH, and total coliform and there is a narrative requirement for toxicants in toxic amounts. In the absence of a state standard for a compound, federal AWQC would be appropriate.</p> <p>Requirements were considered; however, no numerical standards exist for contaminants found in site groundwater which would be discharged to surface water. Federal AWQC will be used in the absence of narrative standards.</p>	These regulations classify the surface waters of the Commonwealth according to the uses of those waters. The Merrimack River has a Class B waterway classification. Class B waters are designated as habitat for fish, other aquatic and wildlife, and for primary and secondary contact recreation. The state surface water minimum criteria for Class B waters are consistent with federal AWQC. These rules are applicable to the Merrimack River, Bridge Meadow Brook, Dunstable Brook, Flint Marsh, and Flint Pond.
	Massachusetts Surface Water Discharge Permit Program (314 CMR 3.00)	Not identified (Add as applicable)	None.	These regulations identify the list of toxic pollutants to be controlled with effluent limitations and are applicable to any current or planned discharge to Bridge Meadow Brook, Dunstable Brook, or Flint Marsh.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Surface Water</u>				
Federal Criteria, Advisories, and Guidance	Federal Ambient Water Quality Criteria (AWQC)	Applicable (Revise to Relevant and Appropriate)	<p>Federal AWQC are health-based and ecologically based criteria which have been developed for 95 carcinogenic and non-carcinogenic compounds.</p> <p>AWQC were considered in characterizing public health risks to aquatic organisms due to contaminant concentrations in surface water at Flint Pond. Because this water is not used as a drinking water source, the criteria developed for aquatic organism protection and ingestion of contaminant aquatic organisms were considered. AWQC were also used as limits for discharge to the Merrimack River.</p>	CERCLA Sec. 121 (d)(2)(A) specifically states that remedial actions shall at least attain federal AWQC established under the Clean Water Act if they are relevant and appropriate. Many of the AWQC have changed since ROD completion, illustrated by Table 1-3. Current AWQC are listed in Table 1-3. These criteria are ARAR for establishing discharge limits to the Merrimack River, Bridge Meadow Brook, Flint Marsh, and Flint Pond.
<u>Air</u>				
Federal Regulatory Requirements	CAA - National Ambient Air Quality Standards (NAAQS) - 40 CFR 40	Relevant and Appropriate	<p>These standards were primarily developed to regulate stack and automobile emissions.</p> <p>Standards for sulfur dioxide, carbon monoxide and nitrogen dioxide apply.</p>	NAAQS need to be used in establishing discharges to the atmosphere. This includes the landfill gas treatment system.
Massachusetts Regulatory Requirements	Massachusetts - Air Quality, Air Pollution (310 CMR 6.00 - 8.00)	Relevant and Appropriate	These standards were primarily developed to regulate stack and automobile emissions.	310 CMR 6.00 provide ambient air quality standards for the Commonwealth, standards for dust are contained in 310 CMR 7.09, and 310 CMR 7.08 provides incinerator standards. These standards need to be used in establishing discharge limits from the landfill gas treatment system.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Air (contd.)</u>				
Federal Criteria, Advisories, and Guidance	Threshold Limit Values (TLVs)	To Be Considered	These standards were issued as consensus standards for controlling air quality in workplace environments. TLVs could be used to assess site inhalation risks for soil removal operations.	There is no change from the ROD presentation for this criteria.
Massachusetts Criteria, Advisories, and Guidance	Massachusetts Guidance on Acceptable Ambient Air Levels (AALs)	To Be Considered	These are guidelines in emission permit writing. AALs were considered when assessing the significance of monitored and modeled residential contamination from air emissions.	There is no change from the ROD presentation for this guidance.

TABLE 1-1 (continued)
POTENTIAL CHEMICAL-SPECIFIC ARARS AND CRITERIA, ADVISORIES, AND GUIDANCE
CHARLES GEORGE LANDFILL, TYNGSBORO, MASSACHUSETTS

MEDIA and AUTHORITY	REQUIREMENT	ROD STATUS	ROD REQUIREMENT SYNOPSIS and CONSIDERATION IN RI/FS	FIVE-YEAR REVIEW
<u>Soil and Sediment</u>				
Federal Regulatory Requirements				
There are no set maximum allowable residual levels for chemicals in soil or sediments under federal law.				
Massachusetts Regulatory Requirements	Massachusetts Contingency Plan - Soil Limits (310 CMR 40.0900)	Not identified (Add as applicable)	None.	<p>The revised MCP (July 1993) identifies reportable concentrations and applicable standards in soil. Site soil at the site is categorized as S-3 due to its low accessibility. The MCP Method 1 soil standards consider both the potential risk of harm resulting from direct exposure to the contaminated soil and potential impacts on groundwater at the site. Method 2 soil standards consider both the potential risk of harm resulting from direct contact with the contaminated soil and the potential for contamination to leach to groundwater.</p> <p>Method 3 sets upper concentration limits in soil which, if exceeded, indicate future potential harm to public welfare and the environment. Soil standards for site COCs, for groundwater classification GW-1 and soil category S-3, Method 1, are presented in Table 1-5. There are no set reportable concentrations for soil categorized as S-3.</p>

TABLE 1-2. COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA^A FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

CHEMICAL	MCL		SDWA ^C		MCLG		314 CMR 5.10 and 314 CMR 6.06 ^E		Mass ¹⁵ ORSGs ^F		Mass ¹⁵ MCL (310 CMR 22.00) ^G	
	1988	1995	1988	1995	1988	1995	1988	1995	1988	1994	1988	1995
COC^B												
acetone	--	--	--	--	--	--	--	--	0.25	3.0	--	--
benzene	0.005	0.005	0	0	0.005	--	--	--	--	--	--	0.005
benzoic acid	--	--	--	--	--	--	--	--	--	--	--	--
2-butanone (MEK)	--	--	--	--	--	--	--	--	0.060	0.35	--	--
1,1-dichloroethene	--	0.007	--	0.007	--	--	--	--	--	--	--	0.007
ethylbenzene	--	0.7	0.68	0.7	--	--	--	--	--	--	0.7	0.7
4-methyl,2-pentanone	--	--	--	--	--	--	--	--	--	--	--	--
4-methylphenol	--	--	--	--	--	--	--	--	--	--	--	--
2-methylphenol	--	--	--	--	--	--	--	--	--	--	--	--
phenol	--	--	--	--	--	--	--	--	--	--	--	--
toluene	--	1	2	1	--	--	--	--	0.34	--	--	1
trichloroethene	0.005	0.005	0	0	--	--	--	--	--	--	--	0.005
arsenic	0.05	0.05	0.05	**	0.05	0.05	0.05	0.05	0.05	--	--	0.05
cadmium	0.010	0.005	0.005	0.005	0.01	0.01	0.01	0.01	0.01	--	--	0.005
chromium (total)	--	0.1	--	0.1	--	0.05	--	--	--	--	--	0.1
copper	--	*	--	1.3	--	1.0	--	--	--	--	--	1.3
mercury	--	0.002	--	0.002	--	--	--	--	--	--	--	0.002
Other Chemicals^I												
1,2-dichloroethane	#	0.005	#	0	#	--	#	--	#	--	#	0.005
methylene chloride	#	0.005	#	0	#	--	#	--	#	--	#	0.005
tetrahydrofuran	#	--	#	--	#	--	#	--	#	1.3	#	--
1,4-dioxane	#	--	#	--	#	--	#	--	#	0.05	#	--
antimony	#	0.006	#	0.006	#	--	#	--	#	--	#	0.006
lead	#	*	#	0	#	0.05	#	--	#	--	#	0.015
nickel	#	0.1	#	0.1	#	--	#	--	#	--	#	0.01
thallium	#	0.002	#	0.0005	#	--	#	--	#	--	#	0.002

TABLE 1-2 (Continued). COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA^A FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN^B WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

CHEMICAL	U.S. EPA Health Advisories ^D							MCP 310 CMR 40 ^H 1993
	One- Day	10- Day		Longer- Term		Life- Time		
	1993	1988	1993	1988	1993	1988	1993	
COC^B								
acetone	--	--	--	--	--	--	--	3
benzene	0.2	0.233	0.2	--	--	--	--	0.005
benzoic acid	--	--	--	--	--	--	--	--
2-butanone (MEK)	**	7.5	**	2.5	**	0.17	**	0.35
1,1-dichloroethene	2	--	1	--	1	--	0.007	0.007
ethylbenzene	30	--	3	--	1	--	0.7	0.7
4-methyl,2-pentanone	--	--	--	--	--	--	--	--
4-methylphenol	--	--	--	--	--	--	--	--
2-methylphenol	--	--	--	--	--	--	--	--
phenol	6	--	6	--	6	--	4	4
toluene	20	6	2	--	2	2.42	1	1
trichloroethene	--	--	--	--	--	0.005	--	0.005
arsenic	--	0.05	--	0.05	--	0.05	--	0.05
cadmium	0.4	0.043	0.04	0.018	0.005	0.005	0.005	0.005
chromium (total)	1	--	1	--	0.2	--	0.1	0.1
copper	--	--	--	--	--	--	--	--
mercury	--	--	--	--	--	--	0.002	0.002
Other Chemicals^I								
1,2-dichloroethane	0.7	#	0.7	#	0.7	#	--	0.005
methylene chloride	10	#	2	#	--	#	--	0.005
tetrahydrofuran	--	#	--	#	--	#	--	--
1,4-dioxane	--	#	--	#	--	#	--	--
antimony	0.015	#	0.015	#	0.015	#	0.003	0.006
lead	--	#	--	#	--	#	--	0.015
nickel	1	#	1	#	0.5	#	0.1	0.1
thallium	0.007	#	0.007	#	0.007	#	0.0004	0.002

TABLE 1-2 (Continued). COMPARISON OF ROD-SPECIFIED NUMERICAL, CHEMICAL-SPECIFIC ARARS AND CRITERIA^A FOR GROUNDWATER AND LEACHATE CHEMICALS OF CONCERN^B WITH CURRENT STANDARDS AND CRITERIA, CHARLES GEORGE LANDFILL, MASSACHUSETTS (All criteria in mg/L)

^A This table provides an update of the regulations and criteria identified in Table 2-1 of the feasibility study (EBASCO, 1988) regulations and criteria.

^B Chemicals of Concern (COCs) drawn from 1988 Record of Decision, Table 6, entitled *CGL Contaminants of Concern - Phase III*. ROD-specified criteria are from Table 2-1 of the Draft Final Feasibility Study Report, Charles George Landfill (EBASCO, 1988).

^C Federal Safe Drinking Water Act, Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs). 40 CFR 141, National Primary Drinking Water Standards.

^D U.S. Environmental Protection Agency, Drinking Water Regulations and Health Advisories, May 1993. One-day, ten-day, longer-term advisories are for 10 kg child; lifetime advisory is for 70 kg adult.

^E The standards listed are under both sets of Massachusetts Department of Environmental Protection Division of Water Pollution Control regulations and are based on Class I and II groundwaters. 314 CMR 5.10, Groundwater Discharge Program, water quality based effluent limitations (primary and secondary). Toxic pollutants without listed limits are subject to Health Advisory criteria. 314 CMR 6.06, Groundwater Quality Standards, provides minimum groundwater quality criteria for Class I and II.

^F Massachusetts Department of Environmental Protection, Office of Research and Standards Guidelines, drinking water guidelines. Autumn 1994.

^G Massachusetts Department of Environmental Protection, 310 CMR 22.00, Drinking Water Regulations, Massachusetts maximum contaminant levels.

^H Massachusetts Contingency Plan, 310 CMR 40.0974(2) Table 1, Class GW-1 Groundwater Standards for a Method 1 risk assessment, per 310 CMR 40.0932.

^I Other chemicals listed, although not identified in the 1988 ROD as chemicals of concern, were analyzed as being present at levels greater than MCLs during sampling between 8/90 and 11/92.

* An action level of 1.3 mg/L for copper and 0.0015 mg/L for lead is provided for in the SDWA regulations. These levels are not MCLs.

** Under review

Not identified in the 1988 ROD.

Shading indicates the value has been updated since 1988.